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High-resolution optical spectroscopy investigation of Nd 2BaNiO 5 and Nd 0.1Y 1.9BaNiO 5 and crystal-field parameters for rare-earth linear-chain nickelates

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Abstract

High-resolution spectroscopy of Nd 3+ in Nd 2BaNiO 5 and Y 2BaNiO 5:Nd(5%) powder samples is used to study Nd 3+ crystal-field levels and exchange splittings in these quasi-on--dimensional model compounds. We demonstrate that the Nd 3+ ground-state splitting in the magnetically ordered state of Nd 2BaNiO 5 (T N = 47.5 ± 1 K, as found from our spectroscopic data) accounts for the low-temperature magnetic properties and for the 4-meV mode observed earlier in inelastic neutron scattering experiments. Crystal-field analysis is performed. Its results show that the directions of ordered magnetic moments in Nd 2BaNiO 5 are determined by the single-ion anisotropy of Nd 3+. We argue that the crystal-field parameters obtained for Nd-nickelate (in this work) and Er-nickelate (in our earlier work) can be used to predict the energy-level patterns and magnetic orooerties of other rare-earth linear-chain nickelates. ©2005 The American Physical Society.

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